

## Radiology Corner

### Tight Left Upper Lobe Collapse from Lung Cancer

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*Note: This is the full text version of the radiology corner question published in the June 2010 issue, with the abbreviated answer in the July 2010 issue.*

We present a case of an 83-year-old male who presented to our emergency department with worsening dyspnea on exertion. Chest radiographs and chest CT revealed tight left upper lobe collapse from an obstructing left hilar mass. In this full-text version, we present a more detailed discussion of this case and the spectrum of tight pulmonary lobar collapse.

#### Summary of Imaging Findings

An 83-year-old male smoker with history of COPD on 2L home oxygen presented to the emergency department with worsening dyspnea on exertion. He had a mild dry cough with an 8 lb weight loss over the past month with no change in appetite. He reported no history of fevers or chills. On exam, he was afebrile with stable vital signs. He was speaking in full sentences without distress, and his pulse oxygen saturation was 90% on 4L oxygen delivered by nasal canula. Physical examination revealed decreased breath sounds in the left superior chest. He was admitted for further evaluation. Initial chest radiographs were obtained (figure 1). The chest radiographs revealed tight left upper lobe collapse resulting in an abnormal left hilar contour, indistinct left heart border, generalized oligemia in the left chest, and dramatic anterior shift of the left major fissure. By report, prior chest radiographs were noted to have “an enlarged left atrial appendage.” Recent prior spirometry was noted to have “decreased FEV1 and FEV1/FVC ratio with hyperbolic expiratory limb of the flow-volume loop suggestive of a severe obstructive defect.” A contrast-enhanced chest CT was performed to further characterize the chest radiograph findings (figure 2). The chest CT revealed a left hilar mass obstructing and encasing the left mainstem bronchus.

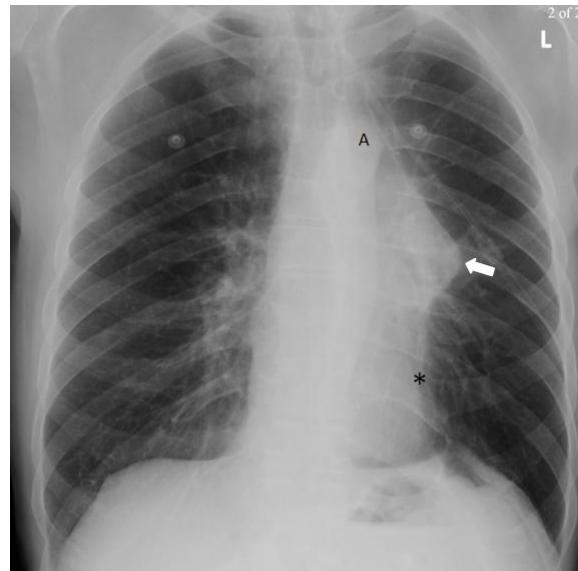


Fig. 1a Posterior-anterior (PA) chest radiograph demonstrating an abnormal left hilar contour (white arrow) in association with indistinct left heart border (\*). There is volume loss and oligemia in the left chest. The oligemic left hilar vessels are visible through the abnormal left hilum. The findings, in association with figure 1b, are consistent with tight collapse of the left upper lobe.



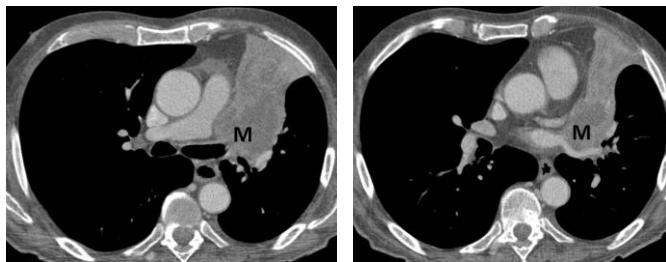
Fig. 1b Lateral chest radiograph demonstrating anterior shift of the left major fissure (white arrows) from tight collapse of the left upper lobe (\*).

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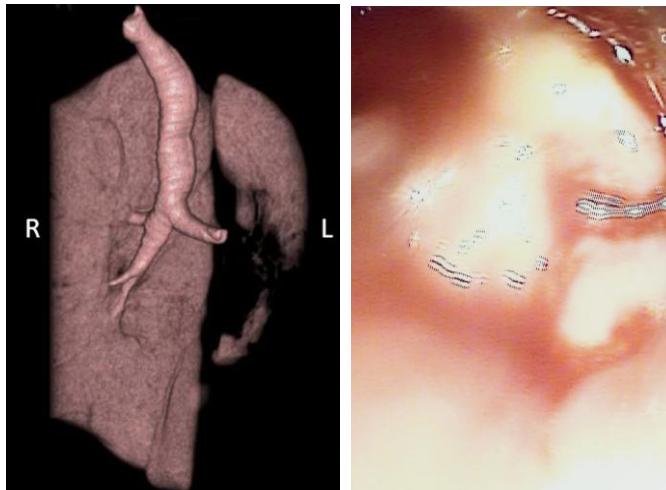
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**Fig. 2** Contrast-enhanced chest computed tomography (CT) demonstrating a left hilar mass (M) obstructing and encasing the left mainstem bronchus. There is mass effect on the left hilar vessels.



**Fig. 3** CT reconstruction (left) demonstrating abrupt cutoff of the left mainstem bronchus. Fiberoptic bronchoscopy image (right) revealing an obstructing endobronchial lesion 4cm distal to the carina in the left mainstem bronchus.

Fiberoptic bronchoscopy was performed (figure 3) revealing a lobulated “fleshy” obstructing mass in the left mainstem bronchus. Brush biopsies of the mass were taken and revealed squamous cell carcinoma.

### Diagnosis:

#### Tight Left Upper Lobe Collapse from Lung Cancer

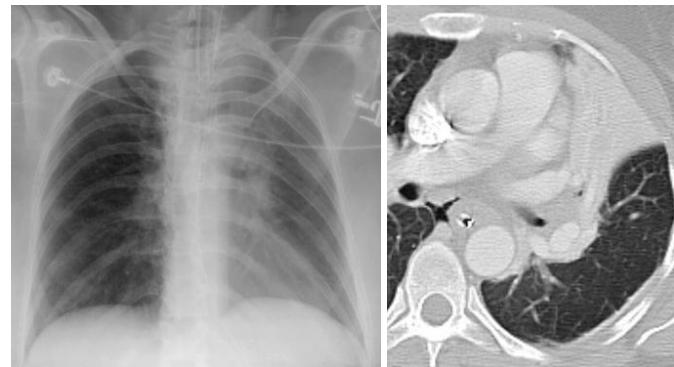
The patient was referred to a major lung cancer treatment center for PET/CT imaging, potential resection, and oncologic treatment.

### Discussion

This case demonstrates the classic findings associated with tight left upper lobe collapse due to an obstructing endobronchial lesion. More importantly, it demonstrates that a collapsed lobe with marked volume loss can be misinterpreted or overlooked on chest radiographs. In reviewing lobar collapse, a typical cause is from proximal occlusion or stenosis of a lobar bronchus. Bronchial neoplasms, such as bronchogenic carcinoma and squamous cell carcinoma, are probably the most important considerations to exclude when assessing lobar collapse in adults and smokers.<sup>1</sup> In young adults (less than age 40), endobronchial carcinoid tumor is common. In post operative

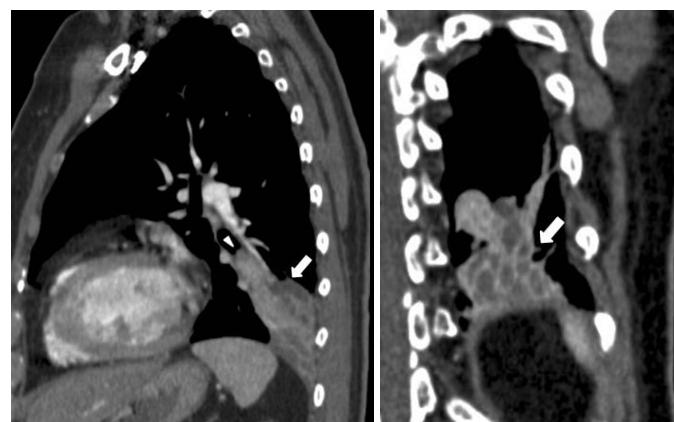
patients, the most common cause is mucous plugging due to accumulation of inspissated secretions in the airway (fig 4). In children and infants presenting with lobar collapse, asthma with resultant mucous plugging, as well as foreign body aspiration, are common etiologies. Other less common causes include fibrotic stenosis from granulomatous disease, post-radiation bronchial stenosis, and inflammatory conditions (eg. polychondritis).

As lobar collapse progresses, there is resultant absorption of air in the distal alveoli, which leads to loss of aeration and atelectasis. Complete resorption of air usually takes place within 24 hours after acute bronchial obstruction (fig 4).



**Fig. 4** Portable anterior-posterior (AP) chest radiograph (left) and contrast-enhanced computed tomography (CT) (right) in a trauma patient with left upper lobe collapse due to obstructing mucus plug.

In contrast, the affected lobe may also develop a fluid-filled expanded appearance (“drowned-lung”) from post-obstructive pneumonitis, mucoid impaction, and fibrinopurulent exudates.<sup>2</sup> A “drowned lung” most commonly occurs in the setting of bronchial obstruction due to bronchogenic carcinoma, but can be seen with bronchial carcinoid tumor (fig. 5). On contrast-enhanced CT images, “drowned lung” has a unique appearance of fluid within distended rim-enhancing bronchi.<sup>3</sup> When identified, a search for an obstructing endobronchial mass should be performed.

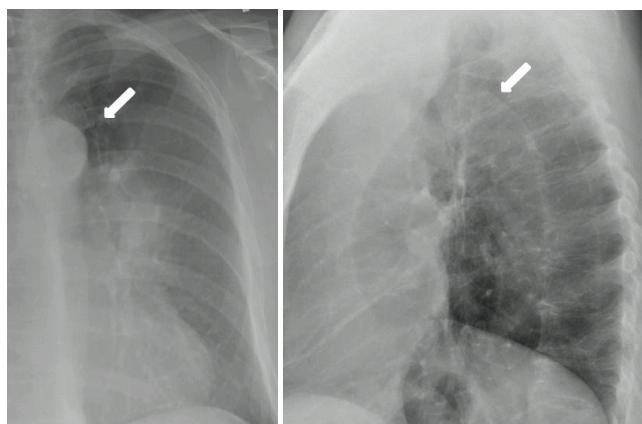


**Fig. 5** Contrast-enhanced chest computed tomography (CT) demonstrating low attenuation fluid within dilated rim-enhancing airways (“drowned lung”- white arrows) in a patient with an endobronchial carcinoid tumor (white arrowhead).

A number of radiographic signs and patterns can be applied to chest radiographs as well as chest CT to accurately and

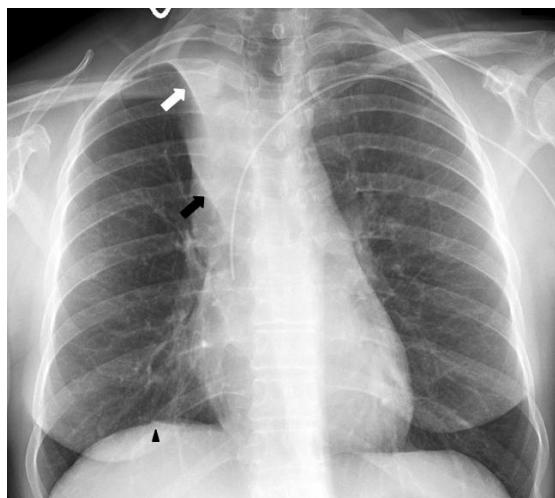
promptly diagnose lobar collapse. These include (i) signs of volume loss, such as tracheal deviation and mediastinal shift towards the side of collapse and hemidiaphragm elevation on the side of collapse, (ii) displaced pulmonary fissures, (iii) “silhouetting” of the cardiomedastinum or diaphragms, (iv) herniation of the opposite lung across midline, and (v) visualization of a mass or foreign body obstructing the airway.<sup>4,5</sup>

In left upper lobe collapse, the lobe collapses anteriorly and superiorly in the chest, abutting the anterior pleural space. This finding is best appreciated on a lateral radiograph (fig 1b). Subsequently, the left lower lobe expands superiorly behind the collapsed lobe, filling the void in the pleural space. On frontal radiograph, a crescentic hyperlucency may be noted adjacent to the thoracic aortic arch in about half of cases (“luftsichel” [air-crescent] sign, see fig. 6).<sup>4</sup>



**Fig. 6** PA and lateral chest radiographs in a patient with tight left upper lobe collapse and hyperexpansion of the left lower lobe. There is resulting hyperlucency (“luftsichel” sign) adjacent to the thoracic aorta.

In tight right upper lobe collapse, the right upper lobe collapses superiorly and medially toward the right paratracheal margin (fig 7).



**Fig. 7a** Portable anterior-posterior (AP) chest radiograph in a patient with tight right upper lobe collapse from lung cancer. The medial aspect of the minor fissure is convex inferiorly (black arrow), and the lateral aspect of the minor fissure is concave inferiorly (white arrow) forming a reverse S. Note a small “juxtaparenchymal peak” on the right hemidiaphragm (black arrowhead).

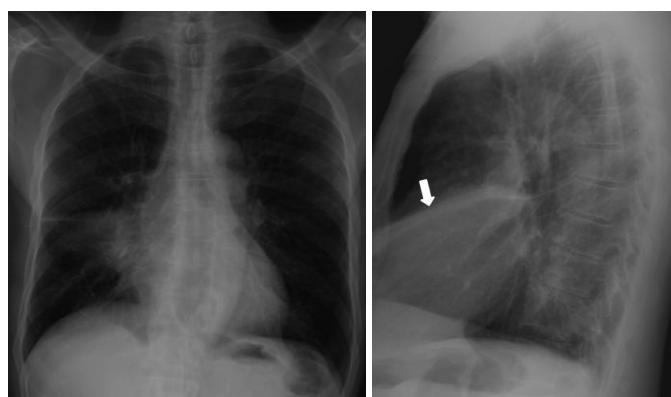
The right minor and major fissures are displaced superiorly, with compensatory hyperexpansion of the right middle and lower lobes. Two radiologic signs are associated with right upper lobe collapse: the “reverse S sign of Golden” and the “juxtaparenchymal peak” (fig 7).



**Fig. 7b** Contrast-enhanced chest computed tomography (CT) in a patient with tight right upper lobe collapse from lung cancer. Note the obstructing mass (black arrow) encasing and narrowing the right upper lobe bronchus.

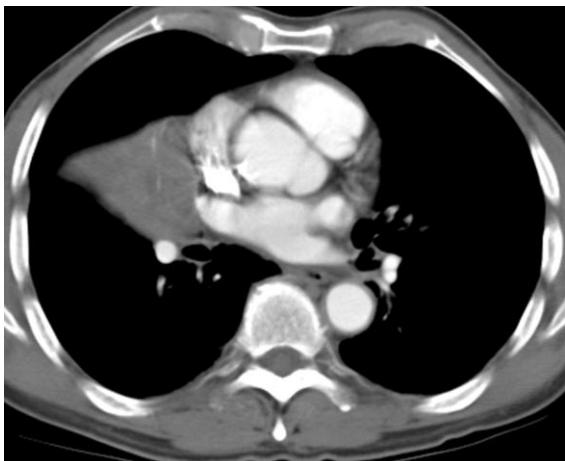
The “reverse S sign of Golden” is created by the appearance of the minor fissure and the collapsed right upper lobe around a central obstructing mass.<sup>4,6</sup> The “juxtaparenchymal peak sign” refers to tenting of the right hemidiaphragm superiorly in the setting of volume loss. It is caused by superior traction on the inferior pulmonary ligament.<sup>4,6</sup>

Tight right middle lobe collapse can also be difficult to diagnose on chest radiographs. The collapsed lobe shifts medially, and may obscure the right heart border. On the lateral radiograph, right middle lobe collapse is seen as a triangular opacity overlying the heart, with approximation of the minor and right major fissure (fig 8a).



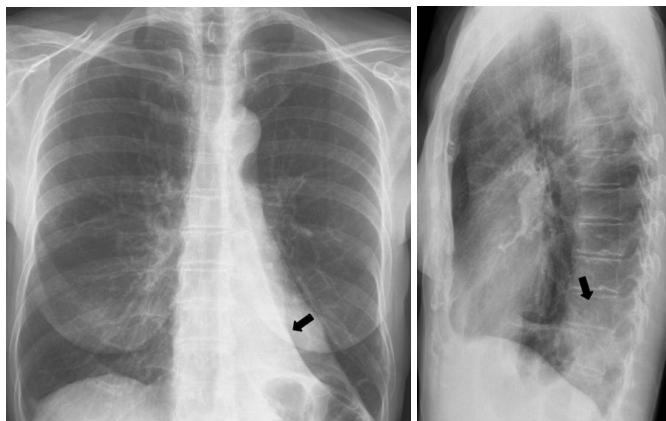
**Fig. 8a** PA (right) and lateral (left) chest radiographs in a patient with tight right middle lobe collapse from lung cancer. Note the band-like white opacity overlying the heart on the lateral view representing the tight collapse of the right middle lobe.

In tight right middle lobe collapse, the hyperexpanded right upper and right lower lobes oppose the collapsed middle lobe, forming a triangular opacity adjacent to the right heart border, with apex directed laterally (fig. 8b).<sup>1,7</sup>



**Fig. 8b** Contrast-enhanced chest computed tomography (CT) in a patient with tight right middle lobe collapse from lung cancer obstructing the right middle lobe bronchus. Note the triangular appearance of the collapsed right middle lobe.

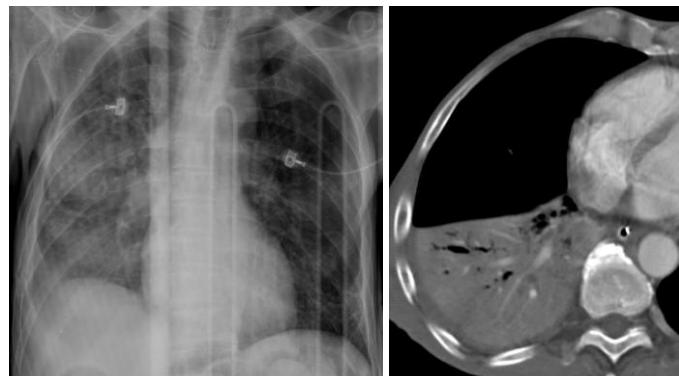
In tight left lower lobe collapse, the left lower lobe collapses medially and inferiorly. The collapsed lobe is noted as a triangular opacity behind the heart with obscuration of the medial left hemidiaphragm (fig. 9).



**Fig. 9** PA (right) and lateral (left) chest radiographs in a patient with tight left lower lobe collapse. Note the triangular white opacity (black arrows) behind the heart obscuring the posteromedial left hemidiaphragm.

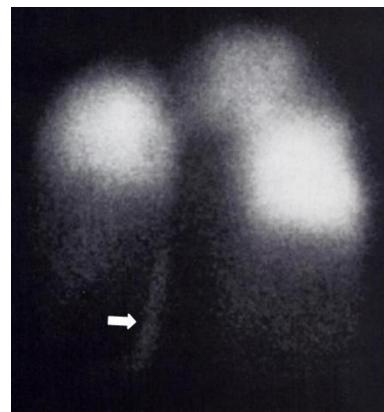
The tightly collapsed left lower lobe typically has a sharply defined lateral margin, which represents the interface between the collapsed left lower lobe and the hyperexpanded left upper lobe. CT typically demonstrates a wedge shaped paraspinal opacity similar to the radiographic findings.<sup>1,7</sup>

Tight right lower lobe (RLL) collapse has similar features to tight lower lower lobe collapse. The right lower lobe collapses medially and inferiorly and can be seen as an area of increased opacification in the posteromedial aspect of the right lower lung. The minor fissure is displaced inferiorly, and the right middle and upper lobes are hyperexpanded. On the lateral radiograph, the collapsed RLL obliterates the posterior third of the right hemidiaphragm. CT demonstrates a triangular opacity adjacent to the right hemidiaphragm and RLL pulmonary artery.<sup>1,7</sup> While conceptually simple to recognize, RLL collapse can be difficult to identify, as in the setting of trauma and supine imaging (fig 10).



**Fig. 10** Portable supine anterior-posterior (AP) chest radiograph (left) and contrast-enhanced CT (right) in a patient with right lower lobe atelectasis seen in the setting of chest trauma. Note the volume loss in the right chest on chest radiograph (left). The opacity in the right chest actually represents a collapsed right lower lobe abutting the posterior right hemithorax.

Scintigraphic perfusion lung scans have also been reported to demonstrate lobar collapse. In 1996, Feldman et al. described a case of tight left lower lobe collapse seen on pulmonary perfusion scintigraphy as a thin rim of perfusion adjacent to the spine, representing the tightly collapsed left lower lobe (fig. 11). This finding has been termed the “pseudo-stripe” sign.<sup>8</sup>



**Fig. 11** Posterior view Tc-99m MAA pulmonary perfusion exam demonstrating a thin rim of peripheral perfusion in the medial left lower lung (white arrow). The adjacent lung is hypoperfused creating the “pseudo-stripe” sign.

As can be seen from these cases, the cause of lobar collapse may not be clear on radiographs, and CT is helpful in assessing a etiology (endobronchial lesion, constricting mass). In a retrospective study of 50 patients with lobar or segmental collapse of the lung, CT was able to identify all cases caused by an obstructing tumor and successfully excluded obstructive tumor in most of the remaining cases.<sup>9</sup>

The treatment of lobar collapse varies depending on the etiology. In mechanical obstruction from mucus plug or aspirated debris, suctioning or coughing may be helpful, but if unsuccessful, bronchoscopy is often performed to remove the obstructing lesion. If an endobronchial mass is present, treatment includes biopsy and subsequent debridement and stenting. For malignant endobronchial masses, other therapeutic modalities such as adjuvant radiotherapy or laser debridement may also be employed.

## Summary

Unlike routine lobar collapse, tight lobar collapse may be overlooked or misinterpreted on radiographs. As outlined in this paper, bronchiogenic carcinoma is the most important cause to consider, and chest CT is helpful in assessing the etiology of tight lobar collapse. Familiarity with tight lobar collapse is important and may prevent potential delay in diagnosis. In the setting of a malignant endobronchial mass causing tight lobar collapse, bronchoscopic biopsy and surgical removal of may improve outcome.

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